OPTIMIZATION OF THE ESRF STORAGE RING LEVEL SURVEY AND NETWORK

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1. INTRODUCTION

Since the start of the ESRF, the levelling campaigns have been made with the WILD-LEICA N3 precise level. It has long been the aim of the ESRF Alignment group to try and replace this level, although arguably the best optical level in the world by an electronic level. The impetus behind this was to decrease the intervention time of a level survey and to eliminate well know problems associated with optical level surveys and in particular operator fatigue. Furthermore, precise optical levels of this type are no longer manufactured. Nevertheless, a number of problems and in particular lighting hampered the use of and diminished the announced precision of modern electronic levels under our conditions of use in accelerator tunnels. The in-house development of an illuminated level staff has finally permitted the use of one such electronic level - the ZEISS DINI 12. This change of instrument has been accompanied by a change in the stationing of the level and a post survey collimation corrections to the measures as a function of distance

2. METHOD COMPARISON

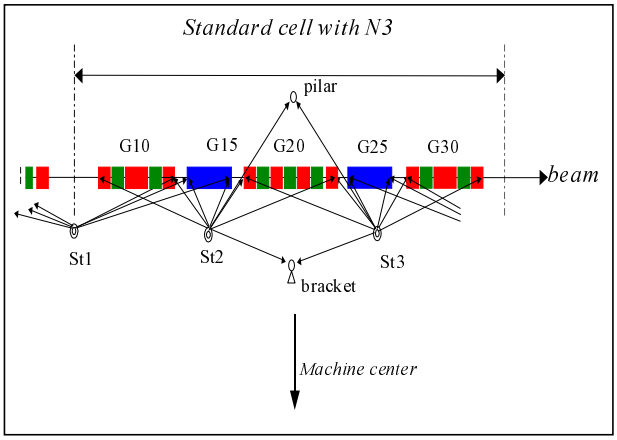


Fig. 1 N3 measurement configuration

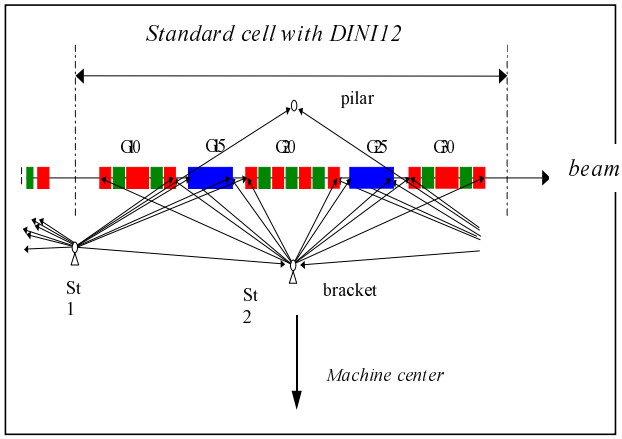
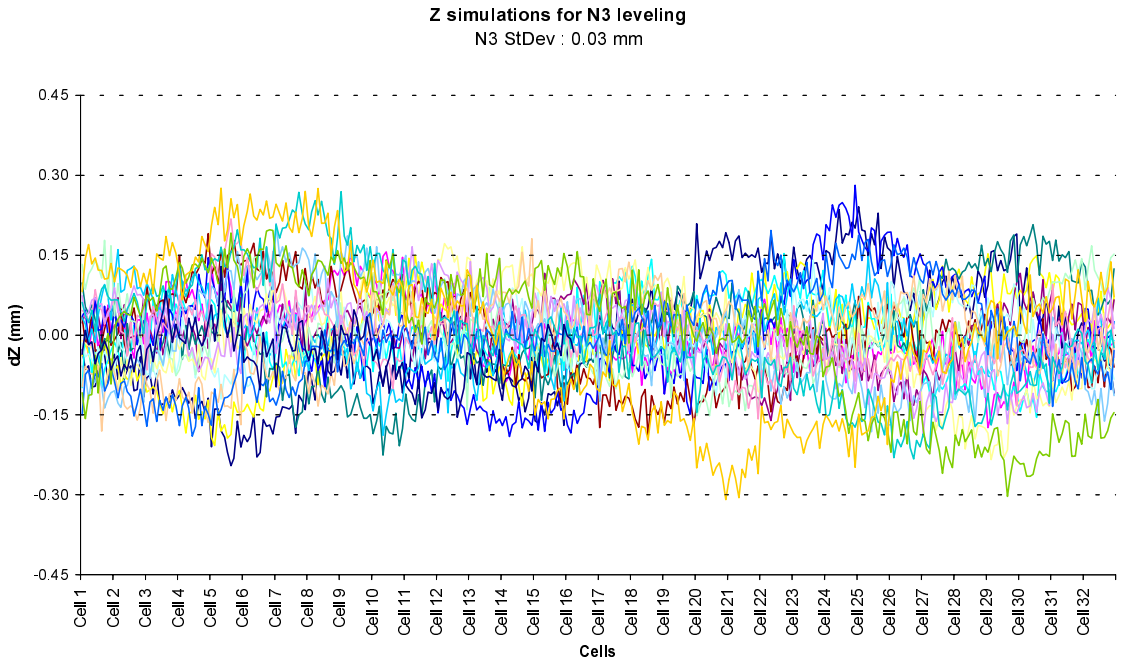


Fig. 2 DINI12 measurement configuration

Table 1 Comparison

N3	DINI12
845 m complete run of storage ring tunnel	845 m complete run of storage ring tunnel
32 cells in storage ring tunnel	32 cells in storage ring tunnel
3 stations per cell	2 stations per cell
Station 1 : 6 observations	Station 1 : 12 observations
Station 2 : 8 observations	Station 2 : 10 observations
Station 3 : 8 observations	
Total : 22 observations	Total : 22 observations
2 pts per cell measured from only one station	2 pts per cell measured from only one station
9 meters : longest distance of observation	13 meters : longest distance of observation
96 stations double height for a complete run	64 stations double height for a complete run
704 observations in a level run	704 observations in a level run

Figure 3 Simulations of the N3 leveling network configuration



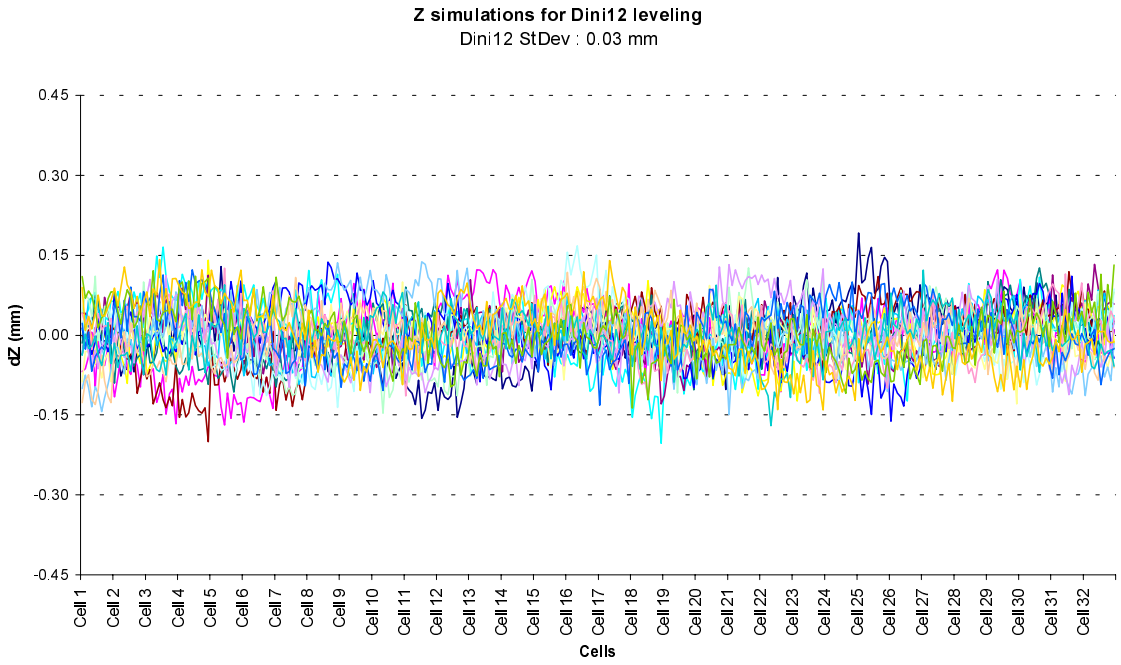


Figure 4 Simulations of the DINI12 leveling network configuration

3. MAIN IMPROVEMENTS

3.1 Evolution from optical N3 level to digital DINI12 level with illuminated staff

- Longest distance of observation almost doubled without accuracy loss.
- Reduction in the number of stations.
- Accuracy independent of operator and of operator fatigue.
- Automatic data recording via RS232

3.2 Change tripod with bracket station

- Increase of stability.
- Observations at optimal height.
- Reduction in risk of accidents.
- Easier working conditions (reduction in overall dimensions).

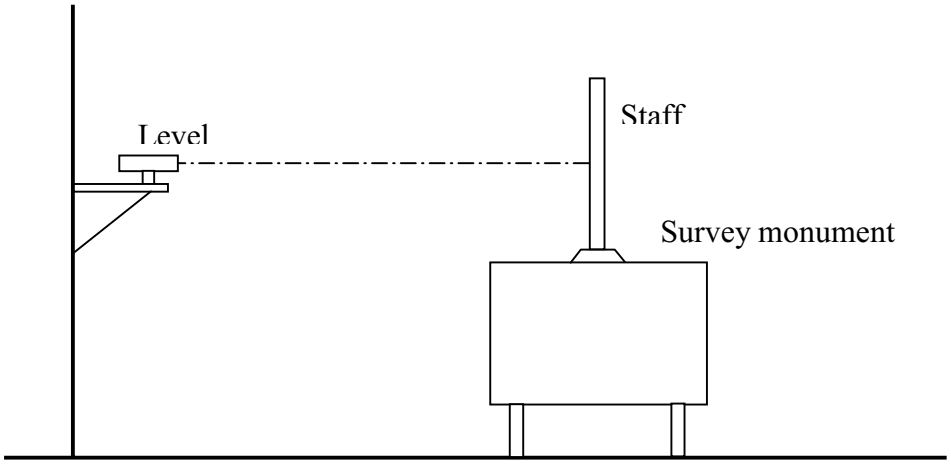
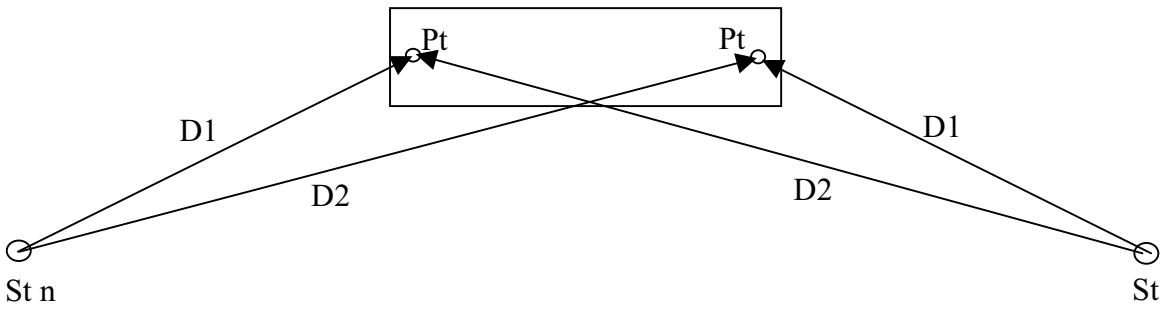


Figure 5 Level network observations setup with the DINI12 electronic level.

3.3 Post survey collimation corrections

- Estimate, by comparison between the differences in height for couples of common points, of the residual error for each level.
- Follow up of this residual default for each level.
- Correction of single point readings to eliminate this error.

Collimation (Coll) error determination



Δn =Read Pt B + Coll x D2 – (Read Pt A + Coll x D1)
$\Delta n+1$ =Read Pt B + Coll x D1 – (Read Pt A + Coll x D2)

Coll = $(\Delta n - \Delta n+1) / 2(D2 - D1)$

3. CONCLUSION & PROSPECTS

This new method has bought a gain in precision and in the time required for a precise level survey of the ESRF storage ring. After five surveys made with this new method, the closure is always better than 0.3 mm. It was typically 0.5 mm with the N3. The average time for a complete levelling survey is down to 5 hours from 8 hours with the N3. In light of these results, consideration is being given to making the same kind of change in the booster.

4. REFERENCES

Many thanks to our colleagues in the Alignment Group.